POLSKA AKADEMIA NAUK
INSTYTUT ZOOLOGICZNY, ODDZIAŁ W KRAKOWIE

ACTA ZOOLOGICA
CRACOVIENSIA

Tom V Kraków, 31 VIII 1960 Nr 8

Zygmunt BOCHEŃSKI

Pokarm puchacza *Bubo bubo* (L.) w Pieninach

Корм филина *Bubo bubo* (L.) в Пенинах

The diet of the eagle-owl *Bubo bubo* (L.) in the Pieniny Mts.

INTRODUCTION

The materials discussed in this paper were collected on the occasion of the investigations of the Pieniny avifauna. I was able to collect them thanks to the fact that several pairs of eagle-owls nested in the Pieniny Mts. in a comparatively small area (FERENS, 1953). Such a great density of eagle-owls is probably connected with favourable breeding conditions in this region. In the Pieniny Mts. eagle-owls nest on small lime rocks looking chiefly toward the south and surrounded with woods. The birds did not build nests in any case observed by me, and the eggs, mostly two in number, lay immediately on a rocky ledge or on the ground at the foot of a rock, at the edge of a talus slope. The eggs may also lie on small bony fragments derived from decomposing pellets and mixed with dust.

The materials have been collected from and observations carried out at three breeding sites in the area of the Pieniny[1]

[1] In May 1960, when my paper had gone to press, another nest of eagle-owls was found in the Pieniny Mts. The material gathered in this nest has been discussed in the Appendix at the end of this paper.

National Park. The first of them was on a rock in the little valley of Ociemne, in the north-eastern part of the Pieniny Mts. It was situated in the upper part of a rock-face on a narrow ledge, as if in a shallow recess. According to the evidence of forester GABRYŚ this nest was occupied in 1956. A part of materials was collected in July 1956, the rest in spring 1957, and in that year no breeding birds were found in the nest. It was only in April 1959 that the flying eagle-owls were observed in this place and fresh pellets and feathers were found at the foot of the rock, testifying that the birds had returned to these environments. However, no nest with eggs was spotted. The second nest was at the foot of a rock-face, above a big scree, on Marcelowa Mt. In summer 1957 it was already left. The whole material of animal remains was then collected, and no eagle-owls have since been noticed there. The third breeding site was not far from the previous one (at a distance of a mile), on the rocks of Rabsztyn. Fresh remains and pellets, found in this place in 1957, proved that some eagle-owls had nested there in that year; the nest itself, however, was reached only in May 1958 (Table 1). It was situated, like that in Ociemne Valley, on a rock ledge under a small cornice. The only difference was that the ledge, on which the eggs were lying, was in the lower part of the rock-face. The materials were collected here from May to August 1958 every several weeks. In April 1959 some fresh vestiges of eagle-owls' presence on Rabsztyn were found, and pellets collected, but there were no eggs in the old place, and no birds were noticed. The late and cool spring of that year might cause the lack of breeding. All the three sites were in woods but at a short distance from open areas.

It is worth while to add a few notes of TACZANOWSKI (1862 and 1882) to complete the picture of the eagle-owl's breeding habits, which include also the selection of a site for nesting. He states that in lowlands eagle-owls occupy old nests of eagles and other birds of prey for breeding season, and that in miry recesses they even breed immediately on the ground or on tussocks in a marshy country. Then they build their nests of grass and water plants, which they accumulate disorderly. The survey of the European literature, however, points out that now eagle-owls nest most preferably on rocks (SCHEFER,

Table 1

Analysis of materials collected in three nests over whole period of investigations

Species	Nest-site: Ociemne	Nest-site: Macelowa Mt.	Nest-site: Rabsztyn	Total	per cent of total number of individuals
Mammalia:					
Lepus europaeus PALL.	1		3	4	2,0
Oryctolagus cuniculus (L.) domestic or wild	1		2	3	1,5
Ondatra zibethica (L.)		1		1	0,5
Arvicola terrestris (L.)	13	18	4	35	17,0
Microtus arvalis (PALL.)	16	5	36	57	~27,0
Rattus norvegicus (BERK.)	6	4	1	11	5,5
Apodemus agrarius (PALL.)	1			1	0,5
Apodemus KAUP sp.?	1		6	7	3,5
Micromys minutus (PALL.)	1		1	2	1,0
Erinaceus europaeus L.	3	1	1	5	2,5
Talpa europaea L.	1			1	0,5
Mustela putorius L.	1			1	0,5
Chiropera non det.	1			1	0,5
(Total of mammals)	—	—	—	129	62,5
Aves:					
Corvus cornix L.			2	2	1,0
Garrulus glandarius (L.)	1		2	3	1,5
Nucifraga caryocatactes (L.)	1			1	0,5
Coloeus monedula L.		1		1	0,5
Pica pica (L.)			1	1	0,5
Falco tinnunculus L.			1	1	0,5
Buteo buteo (L.)			1	1	0,5
Coturnix coturnix (L.)			1	1	0,5
Aves variae non det.	8	3	1	12	6,0
(Total of birds)	—	—	—	23	11,5
Amphibia:					
Rana esculenta L.	7	11	10	28	13,5
Rana temporaria L.	1	4	4	9	4,5
Bufo bufo (L.)		1	1	2	1,0
(Total of amphibians)	—	—	—	39	19,0

Table 1 cd.

Species	Nest-site: Ociemne	Nest-site: Macelowa Mt.	Nest-site: Rabsztyn	Total	per cent of total number of individuals
Pisces:					
Leuciscus cephalus (L.)	1		1	2	1,0
Pisces non det.	1		1	2	1,0
(Total of fishes)	—	—	—	4	2,0
Arthropoda:					
Astacus fluviatilis FABR.	2			2	1,0
Grylotalpa grylotalpa (L.)			ca 3	ca 3	1,5
Coloeoptera non det.			ca 5	ca 5	2,5
(Total of arthropods)	—	—	—	ca 10	5,0
Total	68	49	88	205	100,0

1932; CURRY-LINDAHL, 1950) which may be, according to DEMENTEV (1951), to avoid human interference.

The collected materials have been classified in the Cracow Department of the Zoological Institute of the Polish Academy of Sciences partly by the author himself and partly in cooperation with the respective specialists in various classes of vertebrates: DR. K. KOWALSKI, and MGR. L. SYCH, (mammals), DR. M. MŁYNARSKI, (anurans) and MGR. W. KILARSKI, of the Comparative Anatomy Department of the Jagiellonian Univeristy (remains of chub *Leuciscus cephalus* (L.)) I wish to offer them all my heartiest thanks for help.

DESCRIPTION OF COLLECTED MATERIALS

The materials were collected both in the nests and in their vicinity within a radius ranging from several to some dozens of meters, on the rocks and at their feet as well as under the nests. They consisted mostly of bone fragments derived from the decomposition of pellets as well as of whole pellets, feathers,

wing fragments, hair, fish scales and finally, in the event of invertebrates, chitin remnants. The complete pellets were measured and then wetted all over with water in order to acquire bone fragments from them.

Long bones of limbs, pelves and various fragments of skulls predominate in the bone materials of mammals. Vertebrae and ribs are relatively rare. In skulls the calvariae are, as a rule, destroyed (in the complete collected material only one has been preserved in a vole rat *Arvicola terrestris* (L.) but even this with a big hole on the top), on the other hand, the bones of the visceral parts of skulls are preserved in good condition. Owing to that and particularly owing to the preservation of teeth, the species represented by the bones could be easily identified. As to mandibles, they and especially their dental parts are well-preserved. The ramus of the mandible is at least partly crumbled in about half the specimens. The pelvic bones of small animals are in a good state, though their projecting parts are occasionally crumbled off. The long bones of limbs are preserved whole but those of bigger animals (e. g. hares) are most frequently in fragments. The vertebrae are much more rarely found in the collected materials than it might be inferred from the number of specimens. The remains of hair are found besides the bones, and they are easily identified as regards the hares.

The classification of the bird remains, found in the materials, according to the species, which they belong to, has been carried out mainly on the base of feathers. Whole pieces of wings with their primaries preserved and their arm and forarm muscles stripped off are often present. This occurs in the case of both big birds such as hooded crows *Corvus cornix* L. or buzzards *Buteo buteo* (L.) and small ones like quails *Coturnix coturnix* (L.). The leg bones of big species (e. g. buzzards) are also found, though eagle-owls do not generally swallow them but bite off the muscles from the thighs and lower legs. Then horny plates are preserved on the tarsus and claw on the digits. The remains of lower limbs of smaller birds (e. g. the size of a jackdaw) point at the fact that eagle-owls swallowed them and then spat out in the form of a more or less typical pellet. In this case the bones usually remain joined to each other by means of

tendons and in the pellet they assume the shape of a leg very much bent. Single bones of forarm or hand are, however, found in the bone materials every now and then. Most of bigger long bones are smashed and their fragments, as a rule, do not exceed 8—10 cm. The heads of humeri of bigger birds (e. g. birds of the crow family) are often attached to the bone fragments of the shoulder girdle by means of tendons. This proves that eagle-owls cut off the wings of their victims at the base with their beaks and do not tear them asunder, because in the latter case the shoulder joints would not be preserved complete. The fragments of spines, ribs, pelvic bones (partly crumbled) and single furculae are present in the collected materials besides the long bones. Complete skulls are not found at all and mandibles very rarely. The calvaria fragments of a big bird (buzzard) and a piece of a beak (horny sheath of the lower mandible) belonging to a bird as big as a jackdaw have been also distinguished among the remains of birds.

The remnants of anurans (frogs and toads) are represented mainly by the long bones of limbs and the iliac bones. It deserves to be noted that the bones of pelvic girdle (ilium, pubis and ischium) are not usually found joined together (this was observed only in one case), and that separate ilia predominate, though the end parts of their wings are rather often crumbled off. It is possible, owing to these bones, to determine the remains to an accuracy of a species. The bones of limbs most frequently met are: femur, humerus, os antibrachii and os cruris. Besides, the urostyle is found, though this rather rarely. These bones are preserved whole, only the joint parts sometimes fall off owing to their poor ossification. There are very few skull bones, of which mandibles and parasphenoids are most frequent: The latter bones are of importance when determining the species of a victim. The vertebrae, just as in the case of mammals and birds, are found in a far less quantity than it might be inferred from the number of individuals estimated on the base of other bones.

The fish remains constitute a very small percentage of the materials collected in the Pieniny Mts. Vertebrae and very few skull bones are most often found and they cannot be even used to identify the species represented by them. The pharyngeal

teeth are also present though very rare. In many cases they are characteristic of the species, and it was thanks to them that the presence of a chub *Leuciscus cephalus* (L.) among the fish species was determined. Besides the bones the materials comprise small quantities of fish scales.

Invertebrates also fall victims to eagle-owls and only their hard parts are preserved in pellets. So the remains of a fresh-water crayfish shell have been found. They are rather fragmentary. The pieces of chelae, walking limbs and thorax shells are preserved best. They are stained pink, which points to the chemical reactions occurring during digestion. The chitin fragments of limbs of a mole cricket *Grylotalpa grylotalpa* (L.) as well as the pieces of shells and thoraxes of various beetles are also present.

The foregoing, detailed description of the remains has been presented here in order to make possible their comparison with the fossil materials originating from pellets with which many paleontologists have to do.

Unfortunately only few whole pellets have been found in the collected materials, and so the data concerning their appearance and composition are fragmentary. The pellets are lengthened and somewhat flattened ellipsoids. The bones and other hard parts are in the middle and they are consolidated and surrounded by a rather compact mass of hair and other undigestible components. The length of most pellets ranges from 3.5 to 4.5 cm., though the specimens in which it amounts to 8 and even 10 cm. are not rare. The small pellets are ascribed to the young birds sitting on the nest, whereas the big ones come undoubtedly from the old birds, which can drop them beyond the closest neighbourhood of the nest, and this is why these pellets appear in minority.

The composition of particular pellets is illustrated by the following examples of the results of a few pellet analyses:

1. *Microtus arvalis* (PELL.): incomplete skull with mandibles but with destroyed calvaria, right lower mandible, *Apodemus* KAUP sp.: left lower mandible. Several long bones of small mammals of unidentified species.
2. A few long bones and shoulder blades belonging to several small mammals of unidentified species.

3. *Microtus arvalis* (PALL.): fragments of two skulls, 4 right and 2 left lower mandibles and several bones of limbs. The pellet comprised jointly the fragments of at least four animals, though their bone remains were very incomplete.
4. *Lepus europaeus* PALL.: fragments of skull and femur.
5. A piece of calvaria of a bird, presumably representing the crow family (the feathers found under the nest at that time point at the crow *Corvus cornix* L.).

The several examples above suffice to state that the pellet composition is heterogeneous. A fragmentary character of the remains of bigger animals, such as hares and crows, can be easily explained by the fact that the eagle-owl must rend them asunder and cut them with its beak being unable to swallow them as a whole. Small animals such as mice are swallowed whole. A few pellets are formed of the matter produced from several swallowed animals in the eagle-owl's stomach, none of them, however, corresponds with a particular individual but consists of mixed remains. The same is shown by the composition of a pellet discribed by MÄRZ (1940), in which he found 16 skulls of mice.

The general numerical data, used to make up the list of animals entering into the composition of the eagle-owl's diet in the Pieniny Mts., were estimated so that the least number of individuals computed on the base of the collected materials was assumed for a given species.

The collected materials are tabulated in Table 1, which shows that they comprise the remains of minimum 205 individuals representing at least 28 species. Most of them are mammals: 129 individuals i. e. 62,5 per cent of the total number. The anurans constitute 19 per cent and the birds rank third (11%). The fish and arthropods are decidedly in minority. The members of six species were found in each of the three nests. These are, first of all, small rodents such as common voles *Microtus arvalis* (PALL.), which take precedence of all others for their numerousness, amounting to 57 in total (27 per cent of all preys). They are followed by the vole rat *Arvicola terrestris* (L), whereas the common edible frog *Rana esculenta* L is third before another rodent — the Norwegian rat *Rattus norvegicus* (BERK.), which

is not represented so numerously. These four species may be acknowledged to be predominating from the viewpoint of numerousness i. e. the number of each exceeds 5 per cent of the total. The other species common for the three nests are the common frog *Rana temporaria* L. and the hedgehog *Erinaceus europaeus* L. The remaining species specified in Table 1 were present either in two nests or in one only, and none exceeds 3.5 per cent of the total number of preys.

It is worth while to take notice of another item of the nutritional biology of eagle-owls. In the materials published by Uttendörfer (1939) hedgehogs constitute a large percentage of mammals. The author states that eagle-owls generally begin to eat a hedgehog from its abdominal part, leaving its skin and spines untouched. This is why only few spines are found in pellets. They may become dangerous to the bird; when pierced into the wall of its digestive duct they bring about inflammations. In one of the cases observed by me a hedgehog's spine caused the death of an eagle-owl. In 1957 a forester caught an eagle-owl, which was weak and ill and pursued by some birds of the family Corvidae, in the forest and brought it to the management office of the Pieniny National Park. Here the bird died several days later in spite of its being fed. The post mortem examination revealed that the bird's death had been caused by a hedgehog's spine stuck deep in the back part of the palate.

COMMENTS ON RESULTS

The obtained results allow to draw conclusions concerning the biology of eagle-owls in the Pieniny Mts. The ecology of the species which enter into the food composition of the eagle-owl, elucidates, above all, its choice of the feeding grounds. The common vole *Microtus arvalis* (Pall.) inhabits, first of all, open areas and chiefly cultivated grounds (Pelikan, 1955). The second, for its quantity, component of the eagle-owl's food in the Pieniny, the vole rat *Arvicola terrestris* (L.), is connected with open areas situated near water. The common edible frog *Rana esculenta* L. is also closely connected with

wet and marshy environments and the Norwegian rat *Rattus norvegicus* (BERK.) is met partly in fields and partly in the neighbourhood of human habitations but not in woods. The remaining species of mammals appear in open spaces at least at the time of feeding. Of those the brown hare *Lepus europaeus* PALL., wild rabbit *Oryctolagus cuniculus* (L.), domesticated rabbit, which very often looks for food half-wildly in the fields adjacent to houses and besides them the house mouse *Apodemus* KAUP sp. and the harvest mouse *Micromys minutus* (PALL.) should be mentioned here. Hedgehogs *Erinaceus europaeus* L., whose remains belonging to at least five individuals, were present in the food of eagle-owls, are animals living in various habitats, consequently also in fields. Similarly the polecat *Mustela putorius* L. is met in fields particularly when feeding.

Most of birds that fall victims to the eagle-owl belong to the crow family. The nutcracker *Nucifraga caryocatactes* (L.) lives in coniferous and mixed woods, outside which it may be seen only exceptionally. The hooded crow *Corvus cornix* L., magpie *Pica pica* (L.) and jackdaw *Coloeus monedula* L. look for food mostly in fields, though they nest in woods (crow), in thickets and bushes amid fields (magpie) and in crevices in rocks or in human settlements (jackdaw). The jay *Garrulus glandarius* (L.), reckoned among wood-birds, is, nevertheless, often seen in fields. Similarly the buzzard *Buteo buteo* (L.), which nests in woods, and the kestrel *Falco tinnunculus* L., the typical inhabitant of the Pieniny crags, fly out to prey in fields. The quail *Coturnix coturnix* (L.) is a field bird par excellance.

Of the anurans unmentioned up to now the common frog *Rana temporaria* L. and the common toad *Bufo bufo* (L.) are inhabitants of open spaces. The fish and crayfish are associated with rivers. The mole cricket *Grylotalpa grylotalpa* (L.) is an insect characteristic of fields.

It may be inferred from the survey above that only the birds of the crow family and the buzzard could be caught in woods or a wooded country. It cannot be, however, excluded that the eagle-owl caught them in fields or, which is most probable, on their way back from their feeding grounds in an open area to the wood, and they often return at dusk. It may be, there-

fore, stated that the Pieniny eagle-owls prey, first of all, in open areas, both dry and watered ones, then on the Dunajec-river and eventually on bigger torrents falling into it, but they do not often hunt in woods. It may be added as a complement that the under-developed feathers of a young jackdaw and a young kestrel point to the possibility of their being taken by the eagle-owl out of their nests in rock crevices. The field observations of eagle-owls flying out to prey point at a rather long radius of their hunting flights. According to März (1940) this radius may be as long as 5 km. in summer and 7 km. in winter.

It is generally assumed that owls and among them eagle-owls are night animals. The observations carried out in the Pieniny permit to state that eagle-owls fly out to hunt when it it growing dark. It should be considered in turn in what degre the rhythm of their activity covers the rhythm of activity of their victims. The rhythm of activity in the eagle-owl has not been investigated accurately. Only Hagen (1951) ascertained on the base of his observations of a nest in Norway that there are two peaks of activity, one at about 10.30 p. m. and the other at 2 a. m., but the first one is more intensive. Taking into consideration the duration of a short summer night in high degrees of latitude (59° N) it may be assumed that the observations from the Pieniny Mts., which rendered it possible to fix the greatest activity of the eagle-owl in the first hours of night, conform to the results of Hagen. The activity is only shifted to somewhat earlier hours of night in connection with the earlier falling of darkness. The eagle-owls in the Pieniny Mts. are active till dawn.

The rhythm of activity in some prey animals in the Pieniny region has been already known. So we know that it is a many-phase rhythm in a common vole *Microtus arvalis* (Pall.) (Fig. 1, Diagram 3) with its highest intensity at nightfall (in the first half of night) (Naumow, 1948). One peak of activity at the beginning of night (Fig. 1, Diagram 1 and 2) is distinctly marked in the members of the *Apodemus* Kaup. genus (Naumow, 1948). The rhythm of activity in the vole rat *Arvicola terrestris* (L.) has not been investigated but, inferring from the food composition of this animal, it is most likely to be a many-

phase rhythm in which night activity prevails. The same rhythm may be supposed in rats *Rattus rattus* (L.) and *Rattus norvegicus* (Berk.), since Richter (1922) found it also in an albino rat. According to the data presented by Herter (1934) the hedgehog has a one-phase rhythm with the peak at nightfall (Fig. 2).

As to the buzzard *Buteo buteo* (L.), some slight activity is observed in the night but it is more noticeable in the early

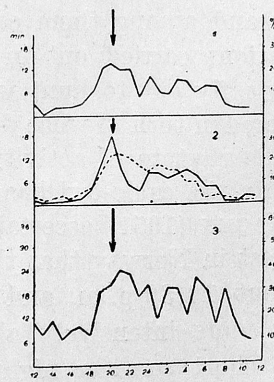


Fig. 1

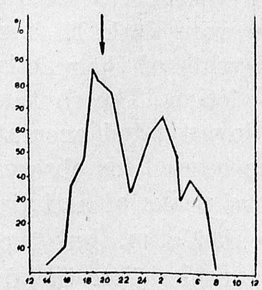


Fig. 2

Fig. 1. Diagram of day-and-night rhythm of activity in small rodents (acc. to Naumov, 1948): 1. — *Apodemus agrarius* (Pall.) 2. — Solid line: *Apodemus sylvaticus* L., broken line: *Apodemus flavicollis* (Mel.). 3. — *Microtus arvalis* (Pall.). The arrows indicate the time, when eagle-owls start hunting. Fig. 2. Diagram of day-and-night rhythm of activity in a hedgehog *Erinaceus europaeus* L. (acc. to Herter, 1934). The arrow indicates the time, when eagle-owls start hunting

night hours than later, which may be stated on the base of the diagrams published by Tabor (1956). The similar occurrence of activity in most birds of the crow family after dark may be acknowledged in consequence of my observations; a great activity of jackdaws, hooded crows and rooks was frequently observed almost in the perfect darkness. Similarly my observations confirm that quails *Coturnix coturnix* (L.) are active and utter voices as late as an hour or two after sunset. An analogous

incidence of activity in the first hours of night has been known in frogs for a long time.

Knowing the habitats of the animals that are preys to the eagle-owl as well as their rhythm of day-and-night activity, we can try to determine the factors which influence the food selection in eagle-owls. When comparing the list of the species of mammals appearing in the Pieniny region with the mammals that enter into the composition of the eagle-owl's, food, we see that a number of small Pieniny animals are not represented in the materials from the pellets. Such species as weasel *Mustela nivalis* L., stoat *M. erminea* L., red squirrel *Sciurus vulgaris* L., dormice: *Glis glis* (L.) and *Muscardinus avellanarius* L., house mouse *Mus musculus* L., bank vole *Clethrionomys glareolus* (SCHREBER) as well as insectovora of the genera *Sorex* L., *Neomys* KAUP. and *Crocidura* WAGLER are lacking. Most of these species live in woods and only some of them appear in open areas.

The problem of the occurrence of birds in the eagle-owl's food presents itself similarly. The avifauna of the Pieniny Mts. is characterized by the prevalence of wood species (BOCHEŃSKI, 1960), few of which, as was mentioned above, occur in the food of eagle-owls. However, there are also many species characteristic of the Pieniny open spaces which are not found in pellets and pluckings. Those are skylarks *Alauda arvensis* L., yellowhammers *Emberiza citrinella* L., white wagtails *Motacilla alba* L. and sparrows, of which mostly tree sparrows *Passer montanus* (L.), wheatears *Oenanthe oenanthe* (L.) and whinchats *Saxicola rubetra* (L.). All these species live there in abundance and are active only in the day-time till dark. Of the birds feeding in open areas only thrushes Turdidae should be named as those which are active notwithstanding it is getting dark. It may be, however, supposed that they are comprised in the diet of the eagle-owl of the Pieniny Mts. though reckoned among the species that have not been distinctly identified.

On the base of the foregoing data, which refer to the feeding grounds of the Pieniny eagle-owl's preys, the rhythm of their activity and the ratio of the species which are hunted for by the eagle-owl to those which are not, it may be stated that one of the factors which renders species liable to become victims,

is the biotope of their occurrence, at least at the time of feeding. This biotope comprises open spaces and of these chiefly cultivated grounds. Another predisposing factor is the rhythm of activity in these animals. The eagle-owl of the Pieniny Mts. hunts only for those species appearing in open areas which are noted for their night activity. The species that have a many-phase rhythm with its peak intensity in the early night hours are particularly numerously killed e. g. *Microtus arvalis* (PALL.), *Arvicola terrestris* (L.), *Rattus norvegicus* (BERK.) and *Erinaceus europaeus* (L.). Of the species with day activity only those are caught whose activity overlaps the early hours of night.

The species that appear in other biotopes as well as those of typical day activity are found in many lists of the eagle-owl's diet and chiefly in the materials presented by UTTENDÖRFER (1932, 1952) but their percentage is so small that they should be treated as exceptions.

Up to the present time the diet of the eagle-owl has been studied among others by MÄRZ (1940) and DRECHSLER (1954) in the Elbsandstein Gebirge, SCHEFER (1932), RICHARD (1923) as well as BURNIER and HAINARD (1948) in the Alps and MOLTONI (1939) in Italy. Some fragmentary and rather general data from Hungary were reported by FARKAS (1954). The studies of MÄRZ (1936) from the Alland Isles, those of CURRY-LINDAHL (1950) from Sweden and of HAGEN (1951) from Norway cover the North European regions. UTTENDÖRFER published a more synthetic works (1939, 1952) based on a bulky comparative material and among others on some of the above-mentioned studies.

The data concerning three nests on the south side of the Tatra Mts. (UTTENDÖRFER, 1935) are especially interesting for their similarity to the materials from the Pieniny Mts. They refer to 596 identified vertebrates, of which 121 belong to *Microtus arvalis* (PALL.), 103 to *Arvicola terrestris* (L.), 184 to *Rana temporaria* L. Among the remains of 27 classified birds partridges *Perdix perdix* (L.) and crows *Corvus cornix* L. were most numerous (six specimens of either).

The general quantitative and percentual specification of animal classes entering into the composition of the eagle-owl's food in various regions of Europe are shown in Table 2. The

Table 2

in various regions of Europe

tiles	Amphibians			Fishes			Invertebrates			Total of preys
More important species		%	More important species		%	More important species		%	More important species	
—	39	19	*R. esculenta* *R. temporaria*	4	2	*L. cephalus*	10	5	*G. grylotalpa* *A. fluviatilis*	205
—	184	31	*R. temporaria*	8	1	*S. trutta*	—	—	—	595
—	28	4	*R. temporiara*	—	—	—	—	—	—	794
—	ca 65	40	non det.	9	5	*C. carpio*	—	—	—	164
—	38	1	*R. temporaria*	2	0	non det.				2744
—	4	0,4	*R. temporaria*	—	—	—	—	—	—	1012
non det.	4	0,8	non det.	53	11	non det.	—	—	—	484
—	16	5	*R. temporaria*	3	1	non det.	—	—	—	316
—	129	46	Anura non det.	—	—	—	—	—	—	283

most important representatives of these classes are also specified in it.

When comparing the percentual composition of the eaglowl's food for various regions, it becomes apparent that the occurrence of a greater amount of amphibians and fishes takes place only in some areas, above all, in the Tatra, in the Alps and in north countries. After a minute analysis of the diet in these regions, it has been found out that bigger mammals and birds (e. g. hares, partridges and ducks) are not represented in it at all or at least appear very seldom. This is connected with the fauna and its quantitative and qualitative wealth in the regions in question. It may be assumed in general that anurans and fishes appear in the diet of an eagle-owl as a substitute element in a country poor in the basic food i. e. middle-sized birds and mammals. According to MÄRZ (1940) the eagle-owl hunts for them very reluctantly in regions abundant in other prey animals. The other possibility of completing their diet is by increasing the amount of small rodents in it (The Tyrol Alps — SCHEFER, 1932).

The Pieniny Mts. are not high and, as a rule, keeping within the boundaries of the leafed tree zone. Most part of these mountains is covered with woods and the field fauna is poor. Of the species found in the eagle-owl's food hares are here in scarcity and partridges, which constitute one of the most important components in Middle Germany, appear very rarely (BOCHEŃSKI, 1960). Only small rodents are in abundance. This is why anurans also appear in the eagle-owl's diet beside its essential food (birds and mammals). However, the ratio of the anurans to the total number of preys is here not so high as it is in the Tatra Mts., the Alps, described by RICHARD, 1923) or in Norway and in general it may be assumed that from the viewpoint of eagle-owl's feeding possibilities the Pieniny Mts. are a rather poor region and have a middle position between lowlands rich in food (Germany, Hungary) and highlands (the Alps, the Tatra Mts.) or countries far on the north, where food is scarce. Paralelly the areas of Sweden or of the Alland Isles have a medial position on the north.

APPENDIX

On 12 th May 1960 I managed to visit another nest of an eagle-owl in the Pieniny Mts. It was situated at the root or a rock-face on the western slope of the Łąnny Potok Valley. Two several-day old nestlings were sitting on crow feathers and bone remnants in the nest. The following species have been identified among the remains collected in the nest and its vicinity:

Mammalia:	
Arvicola terrestris (L.)	1
Microtus sp.	4
[redacted]	
Micromys minutus (PALL.)	
Aves:	
Corvus cornix L.	1
Pica pica (L.)	1
Strix aluco L.	2
Amphibia:	
Rana sp.	3

The species, which I did not find in the other nests, are [redacted] and the tawny owl. The finding of the tawny owl's remnants is particularly interesting, as this bird is a very rare one in the Pieniny Mts. (BOCHEŃSKI, 1960), though in other regions, e. g. in Elbsandstein Gebirge, it is numerously represented in the eagle-owl's diet (MÄRZ, 1940).

REFERENCES

BOCHEŃSKI Z. 1960. Ptaki Pienin. Acta Zool. Cracoviensia. Kraków. V. (in press).

BURNIER and HAINARD. 1948. (cited after UTTENDÖRFER, 1952).

CURRY-LINDAHL K. 1950. Berguvens, *Bubo bubo* (L.), förekomst i Sverige jämte nagot om dess biologi. Var Fagelvärld. Stockholm. **9** (**3**): 113—165.

DEMENTEV G. P. et all. 1951. Pticy Sovetskogo Sojuza. [The Birds of the Soviet Union] Moskva. vol. 1.

Drechsler. 1954. Uhu-Dämmerung. [diet pp. 30—31].

Farkas T. 1954. Bird-Faunistical and Coenological Researches at the Lake of Solymar. Aquila. Budapest. **55—58**: 148—158.

Ferens B. 1953. Puchacz, *Bubo bubo* (L.) w Polsce. Ochrona Przyrody. Kraków. **21**: 78—114.

Hagen Y. 1951. Noen iakttagelser over hubro (*Bubo bubo* L.) i Rogaland. Stavanger Museum Arbok. Stavanger. **1950**: 93—110.

Herter K. 1934. Körpertemperatur und Aktivität beim Igel. Zeitschr. f. vergl. Physiol. **20**: 501—544.

März R. 1936. Der Uhu auf Aland. Beitrag zur Ernährungsbiologie. Ornis Fennica. Helsinki. **13** (**1**): 23—34.

— 1940. Querschnitt durch eine mehrjährige Nährungs-kontrolle einiger Uhupaare. Beitr. f. Fortpfl.-Biol. d. Vögel. Berlin. **16** (**4**): 125—135; (**5**): 166—173; (**6**): 213—222.

Moltoni E. 1939. Di che cosa si natre il Gufo reale — *Bubo bubo* (Linneo). Natura. Riv. di Sc. Nat. Milano. **30** (**2**): 76—81.

Naumov N. P. 1948. Očerki sravnitelnoj ekologii myševidnich gryzunov. [Problems of comparative ecology of mouse-like rodents.] Moskva—Leningrad.

Pelikan J. 1955. Studie o stanovištích hraboše polniho (*Microtus arvalis* Pall.). Práce Brněnské základny CSAV. Brno. **27** (**1**): 1—32.

Richard A. 1923. Nos Oiseaux 55/56. [cited after Schefer, 1932].

Richter C. P. 1922. Behaviouristic study of the activity of the rat. Comp. Psychol. Monogr. **1**: 1—35.

Schefer H. 1932. Ueber die Ernährung der Jungen des Uhus in den Alpen. Beitr. z. Fortpfl.-Biol. d. Vögel. Berlin. **8** (**6**): 222—224.

Tabor T. 1956. The 24-hour rhythm of activity in the common buzzard (*Buteo buteo* L.) and in the rough-legged buzzard (*Buteo lagopus* L.) in different conditions of lighting. Acta Biol. Exper. Warszawa. **17** (**1**): 5—26.

Taczanowski W. 1862. Opisy (K. Tyzenhauza: Oologia ptaków polskich) [eagle-owl, p.: 92—84].

— 1882. Ptaki krajowe. v. 1. [eagle-owl p.: 144—148].

Uttendörfer O. 1939. Die Ernährung der deutschen Raubvögel und Eulen. [eagle-owl p.: 286—302]. Berlin.

— 1952. Neue Untersuchungen über die Ernährung der Greifvögel und Eulen. [eagle-owl p.: 99—109]. Stuttgart.

STRESZCZENIE

Materiał omawiany w tej pracy został zebrany przy okazji badań ornitofauny Pienin w latach 1956—59 i pochodzi z trzech stanowisk lęgowych na terenie Pienińskiego Parku Narodo-

wego tj. z doliny Ociemne, z Macelowej Góry i Rabsztyna. We wszystkich trzech obserwowanych przypadkach puchacze nie budowały właściwego gniazda, a jaja leżały bezpośrednio na skale, lub na szczątkach kostnych, pozostałych z rozpadłych wypluwek i zmieszanych z pyłem. Materiał zbierany był w gniazdach i najbliższej ich okolicy w promieniu kilkudziesięciu metrów.

Na materiał składają się przede wszystkim szczątki kostne z rozpadłych wypluwek, całe wypluwki, pióra, skrzydła i łapy ptaków oraz inne części twarde. Kości zwierząt w wypluwkach puchaczy wykazują charakterystyczne uszkodzenia. Kości drobnych ssaków zachowują się zazwyczaj dobrze, natomiast większych (np. zająca) zwykle spotykane są we fragmentach. Puszki mózgowe czaszek ulegają zniszczeniu prawie zawsze, a trzewioczaszka z zębami i żuchwy zachowują się dobrze. W przypadku ptaków czaszki zachowują się źle, a kości długie spotyka się przeważnie we fragmentach. Ze szczątków płazów bezogonowych najczęściej znajduje się kości biodrowe.

Ogólne zestawienie zdobyczy puchacza w Pieninach przedstawia tabela 1. Widać z niej, że większość (63%) z ogólnej liczby 205 osobników zidentyfikowanych w materiale stanowią ssaki, drugie miejsce z punktu widzenia liczebności zajmują płazy (19%), a trzecie ptaki (11%). Ryby i bezkręgowce stanowią zdecydowaną mniejszość. Gatunkami dominującymi, których szczątki stanowią przynajmniej 5% ogólnej liczby ofiar są: polnik zwyczajny *Microtus arvalis* (PALL.) — 28%, karczownik *Arcicola terrestris* (L.) — 17%, żaba wodna *Rana esculenta* L. — ok. 14% i szczur wędrowny *Rattus norvegicus* (BERK.) — nieco powyżej 5%.

Z przeglądu ekologii gatunków licznie łowionych przez puchacze w Pieninach wynika, że żerują one głównie na terenach otwartych oraz w miejscach wilgotnych nad Dunajcem. Z gatunków leśnych występują w pokarmie tylko ptaki: myszołów *Buteo buteo* (L.) i krukowate *Corvidae*. Przynajmniej częściowo ptaki te mogły być jednak złapane też w terenach otwartych, gdzie większość ich żeruje. Z analizy dobowej rytmiki aktywności łowionych zwierząt okazuje się, iż puchacze łowią przede wszystkim zwierzęta o aktywności nocnej, a szczególnie licznie reprezentowane są gatunki o rytmice wielofazowej, której naj-

większe nasilenie przypada na pierwsze godziny nocy. Uwidaczniają to wykresy (ryc. 1, 2).

W stosunku do innych terenów Europy (por. tabela 2) Pieniny stanowią raczej ubogi teren z punktu widzenia możliwości żerowiskowych dla puchaczy. Wskazuje na to występowanie w pokarmie puchaczy dużego odsetku żab, które są pokarmem zastępczym. Liczne występowanie żab w pokarmie puchaczy zanotowano też w Tatrach, Alpach i Norwegii.

W Dodatku uwzględnione zostały materiały zebrane w maju 1960 w gnieździe nad Łąnnym Potokiem, które zostało znalezione już po oddaniu pracy do druku.

РЕЗЮМЕ

Материал для настоящей работы собран был при случае орнитологических исследований, которые были проведены в Пенинах в 1956—59 годах и получен из трех мест гнездовий, расположеных на территории Национального Парка в Пенинах, а именно: из долины Отемне, Мацелевой Горы и Рабштына. Во всех трех случаях, филины не строили собственного гнезда, а яйца лежали непосредственно на скале или на костных останкап нз распавшихся и смешанных с пылью погадок. Материал собран был в гнездах и в их ближайшей окрестности, в радиусе нескольких десятков метров.

В материале, главным образом находятся костные останки из из распавшихся погадок, цельные цогадки, рерья, крылья и лапы птиц, а также и другие твердые части. Кости зверей в погадках филинов обнаруживают характерные повеждения. Кости мелких млекопитающих (н п. зайца), находятся обыкновенно в частичном виде. Черепы почти всегда бывают разрушены, тогда как челюсти с зубами сохраняются обыкновенно хорошо. У птиц, черепы в большинстве случаев плохо сохраняются, а длинные кости сохраняются в виде фрагментов. Из останков бесхвостных пресмыкающихся, чаше всего припадаются кости ведер: общая сводка добычи филина в Пенинах представлена на таблице 1. На основании этой сводки выходит что большую часть (63°/₀) из общего числа 205 определенных особей в собранном материале составляют млекопитающие,

на втором месте, с точки зрения численности, находятся пресмыкающиеся (19%), на третьем месте — птицы (11%). Рыбы и безпозвоночные находятся в очевидном миньшинстве. Доминирующими видами, которых останки составляют по крайней мере 5% общего числа жертв, являются *Microtus arvalis* (PALL.)—28%. *Arcicola terrestris* (L.)—17%. *Rana esculenta* L.—около 14% и *Rattus norvegicus* (BERK.)—немного более 5%.

Из просмотра экологии видов, обильно ловленных филинами в Пенинах вытекает, что филины главным образом питаются в местах открытых, а также в местах сырых над Дунайцем. Из лесных видов, найдены в корме только птицы: Сарыч [*Buteo buteo* (L.)] и вороновые *(Corvidae)*. Отчасти птицы эти могли быть однако пойманы в открытой местности, где большинство из них собирает пищу. Из анализа суточной ритмики активности ловленных филинами зверей вытекает, что они главным образом ловят зверей с ночной активностью, а особенно многочисленно представлены виды с многофазной ритмикой, напряжение которой замечается в начале ночн. Представлено это наглядно в диаграмме (рис. 1 и 2).

По отношению к другим терреториям Европы (сравни табл. 2), Пенины являются скудной, с точки зрения возможности пропитания филинов местностю. На это обстоятельство указывает присутствие в корме филинов большого процента останков жаб, которые представляют замещающий корм. Многочисленные находки жаб в корме филинов отмечены в Татрах, Альпах и Норвегии.

PLATES

Plate LII

1. Eagle-owl's nest on rocky ledge on Rabsztyn in the Pieniny Mts. May 1958.
2. Young eagle-owls on the nest on Rabsztyn in the Pieniny Mts. May 1958. Note a fish brought for the birds and lying beside them.



Fig. 1
Auctor phot.



Fig. 2

Phot. K. Malski

Zygmunt Bocheński

Redaktor zeszytu: Doc. dr K. Kowalski

Państwowe Wydawnictwo Naukowe — Oddział w Krakowie 1950

Nakład 800+150 egz. — Ark. wyd. 1,75 — Ark. druk. $1^1/_2$ + 1 wkładka — Papier ilustr. kl. III 80 g 70×100 Zam. 157/60 Cena zł 10,—

Drukarnia Uniwersytetu Jagiellońskiego w Krakowie